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(71)Applicant : FUJITSU LTD

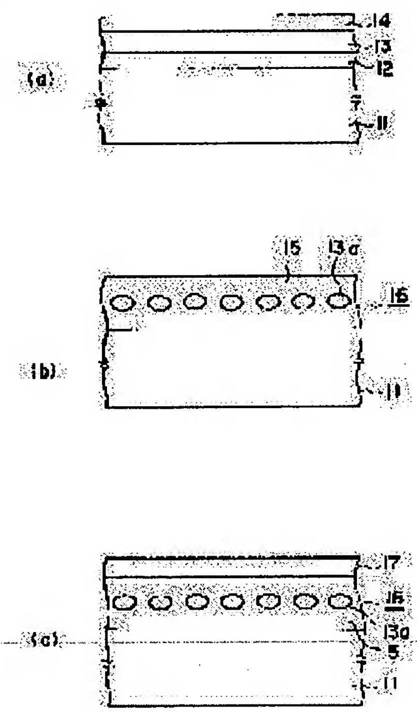
(72)Inventor : KAIZU KATSUTAKE
OKAMOTO IWAO
SHINOHARA MASAKI

(54) PRODUCTION OF MAGNETIC RECORDING MEDIUM

(57)Abstract:

PURPOSE: To reduce the thickness of a recording layer as well as to suppress magnetic interaction between grains of a ferromagnetic substance in the recording layer by isolating the grains from each other and to ensure necessary magnetic characteristics with respect to coercive force, residual magnetic flux density, etc.

CONSTITUTION: A nonmagnetic film 12, a ferromagnetic film 13 and a nonmagnetic film 14 are successively laminated on a nonmagnetic substrate 11 and the films are heated to form a recording layer 16 contg. grains 13a of a ferromagnetic substance in a nonmagnetic film 15.



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CLAIMS

[Claim(s)]
[Claim 1] The manufacture approach of the magnetic-recording medium characterized by heat-treating and forming the record layer which the crystal grain of a ferromagnetic distributed into a nonmagnetic membrane after carrying out the laminating of a nonmagnetic membrane, a ferromagnetic, and the nonmagnetic membrane to order on a nonmagnetic substrate.
[Claim 2] The manufacture approach of the magnetic-recording medium according to claim 1 characterized by making temperature of said heat-treatment into 400 degrees C or more.
[Claim 3] Whenever [dissolution / of the crystal grain of said ferromagnetic in said nonmagnetic membrane] is the manufacture approach of the magnetic-recording medium according to claim 1 or 2 characterized by being 5% or less in ordinary temperature.
[Claim 4] The residual magnetization of said record layer and the product of thickness which were formed are the manufacture approach of the magnetic-recording medium according to claim 1 to 3 characterized by being below 100 Gauss-mu m.
[Claim 5] The manufacture approach of the magnetic-recording medium according to claim 1 to 4 characterized by using the alloy which uses cobalt or cobalt as a principal component as said ferromagnetic, using a metal, oxide, a nitride, carbon, or carbide as said nonmagnetic membrane.
[Claim 6] Said metal is the manufacture approach of the magnetic-recording medium according to claim 5 characterized by being silver or copper.
[Claim 7] Said oxide is the manufacture approach of the magnetic-recording medium according to claim 5 characterized by being silicon oxide or a zirconic acid ghost.
[Claim 8] Said nitride is the manufacture approach of the magnetic-recording medium according to claim 5 characterized by being titanium nitride or a silicon nitride.
[Claim 9] The alloy which uses said cobalt as a principal component is the manufacture approach of the magnetic-recording medium according to claim 1 to 8 characterized by being any one of CoA Cr100-A (A being 90 or more), CoA Pt100-A, or (A being 70 or more, and 40-50) CoA Sm100-A (A being 83.3 or 89.5).
[Claim 10] Said nonmagnetic substrate is the manufacture approach of the magnetic-recording medium according to claim 1 to 9 characterized by being silicon or carbon.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach of the magnetic-recording medium of high power in a low noise in more detail about the manufacture approach of a magnetic-recording medium.
[0002]
[Description of the Prior Art] The magnetic recording medium used as external storage of an information processor requires improvement in recording density increasingly with the increment in amount of information. By the magnetic-recording medium used conventionally, if recording density is made high, a S/N ratio will fall. That is, a playback output will decline and a noise will increase.
[0003] Furthermore, since the S/N ratio of the reproducing head improved by leaps and bounds by utilization of a magneto-resistive effect mold MR head, the noise of the magnetic-recording medium which was seldom conspicuous until now came to occupy most total noises of a magnetic disk drive. Therefore, in order to obtain the magnetic disk drive of a high S/N ratio, the magnetic-recording medium of a low noise is demanded with the high playback output.
[0004] The main things originate in the ambiguity of the boundary of the magnetization transition region by dispersion in magnetization of a magnetization transition region among the causes of generating of the noise of a magnetic-recording medium, and the ambiguity originates in the magnetic interaction between the crystal grain of the ferromagnetic which constitutes a ferromagnetic layer. That is, it is thought that it is because the clearance of the crystal grain of an adjoining ferromagnetic varies.
[0005] For reduction of the noise of a magnetic-recording medium, it is required to weaken the magnetic interaction between the crystal grain of this ferromagnetic, as the clearance more than fixed is maintained among the crystal grain of all adjoining ferromagnetics. As for the record layer of the conventional magnetic-recording medium, it is common to use the thin film which created the 3 yuan or 4 yuan alloy layer which made chromium and cobalt the keynote by sputtering. The segregation of a ferromagnetic part and a nonmagnetic part was urged according to the presentation and creation conditions, and reduction of a noise was in drawing.
[0006] The configuration of the magnetic-recording medium applied to the conventional example at drawing 7 is shown. It is [the chromium film 2 and] CoCr12Ta2 on the nonmagnetic substrate 1 which consists of an aluminum substrate which covered the NiP film as shown in drawing 7. The record layer 3 which consists of film, and the protective layer 4 which consists of a carbon film are formed in order.
[0007]
[Problem(s) to be Solved by the Invention] However, since the cobalt system alloy conventionally used as a record layer 3 was a dissolution system fundamentally, even if it promoted the segregation according to a presentation and creation conditions, it was difficult to isolate the crystal grain of a ferromagnetic thoroughly, and it difficult [it] to cut off the magnetic interaction between these.
[0008] Moreover, after creating at once the 2 yuan or 3 yuan alloy layer of non-magnetic material, such as silver and copper, and the ferromagnetic which cannot dissolve easily to this non-magnetic material

by sputtering as the formation approach of a ferromagnetic layer as indicated by JP,59-42642,A and JP,59-220907,A, there is the approach of heat-treating that thin film and forming the record layer of a magnetic-recording medium. Thereby, high coercive force is acquired.
[0009] However, thickness is formed thickly and the above-mentioned ferromagnetic layer is considered that a t-Br product becomes as high as 2000 or more. For this reason, in the magnetic recording medium which used the magneto-resistive effect mold MR head for the playback section, when using this ferromagnetic layer as a record layer of a magnetic-recording medium, the engine performance of a magneto-resistive effect mold MR head with high sensibility is not matched, but lowering of a playback output is caused on the contrary. By the way, as for especially the t-Br product of the magnetic-recording medium applied to a magneto-resistive effect mold MR head, it is desirable that they are below 100 Gauss-mu m below 150 Gauss-mu m.
[0010] Therefore, although thickness of the above-mentioned record layer needed to be made thin, when the ferromagnetic layer of thin thickness was formed by the above-mentioned spatter, there was a problem that magnetic properties required about coercive force, a residual magnetic flux density, etc. were not acquired. This invention is created in view of the trouble of the above-mentioned conventional example, and it aims at offering the manufacture approach of a magnetic-recording medium that thickness of a record layer can be made thin and magnetic properties required about coercive force, a residual magnetic flux density, etc. can be acquired while it isolates the crystal grain of the ferromagnetic in a record layer mutually and controls the magnetic interaction between these.
[0011]
[Means for Solving the Problem] After the above-mentioned technical problem carries out the laminating of a nonmagnetic membrane, a ferromagnetic, and the nonmagnetic membrane to the 1st on a nonmagnetic substrate at order, Heat-treat and it is attained by the manufacture approach of the magnetic-recording medium characterized by forming the record layer which the crystal grain of a ferromagnetic distributed into a nonmagnetic membrane. It is attained by the manufacture approach of the magnetic-recording medium a publication by the 1st invention characterized by making temperature of said heat-treatment into 400 degrees C or more the 2nd. Whenever [dissolution / of the crystal grain of said ferromagnetic in said nonmagnetic membrane] is attained in ordinary temperature by the 3rd by the manufacture approach of a magnetic-recording medium given in the 1st or 2nd invention characterized by being 5% or less. The residual magnetization of said record layer and the product of thickness which were formed by the 4th It is attained by either the 1st characterized by being below 100 Gauss-mu m thru/or the 3rd invention by the manufacture approach of the magnetic-recording medium a publication. A metal, an oxide, a nitride, carbon, or carbide is used for the 5th as said nonmagnetic membrane. It is attained by either the 1st characterized by using the alloy which uses cobalt or cobalt as a principal component as said ferromagnetic thru/or the 4th invention by the manufacture approach of the magnetic-recording medium a publication. It is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by said metal being silver or copper the 6th. To the 7th said oxide It is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by being silicon oxide or a zirconic acid ghost. To the 8th said nitride The alloy which is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by being titanium nitride or a silicon nitride, and uses said cobalt as a principal component the 9th CoA Cr100-A (A is 90 or more), It is attained by either the 1st characterized by being any one of CoA Pt100-A or (A being 70 or more, and 40-50) CoA Sm100-A (A being 83.3 or 89.5) thru/or the 8th invention by the manufacture approach of the magnetic-recording medium a publication. To the 10th Said nonmagnetic substrate is attained by either the 1st characterized by being silicon or carbon thru/or the 9th invention by the manufacture approach of the magnetic-recording medium a publication.
[0012]
[Function] In the manufacture approach of the magnetic-recording medium of this invention, in order to form a record layer, after forming a nonmagnetic membrane, a ferromagnetic, and a nonmagnetic membrane independently, respectively, the crystal grain of a ferromagnetic is distributed in a

nonmagnetic membrane by heat-treatment. Thereby, it becomes possible to make extent it the crystal grain of all adjoining ferromagnetics does magnetic effect mutually, and they do not suit in a record layer estrange the crystal grain of a ferromagnetic. In this case, that effectiveness will become remarkable if the non-magnetic material to which a ferromagnetic hardly dissolves especially is used.
[0013] Therefore, magnetization distribution of a magnetic-recording medium can be equalized and the noise figure resulting from uneven magnetization distribution of the magnetization transition region of a magnetic-recording medium and its periphery can be improved. Moreover, since it becomes possible to form a record layer which it is thin thickness, and has sufficient coercive force, and the product of a residual magnetic flux density and thickness becomes below 100 Gauss-mu m by the above-mentioned manufacture approach, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.
[0014] Furthermore, while heat-treating more than at an elevated temperature, for example, 400 degrees C, and promoting counter diffusion, it becomes possible to acquire still higher coercive force by acquiring the crystal structure which produces magnetization sufficient as crystal grain of the dispersed ferromagnetic. In the above, the alloy which uses cobalt or cobalt as a principal component, for example, CoA Cr100-A, (A is 90 or more), CoA Pt100-A, or (A is 70 or more, and 40-50) CoA Sm100-A (A is 83.3 or 89.5) can be used as an ingredient of a ferromagnetic, and a metal, an oxide, a nitride, carbon, or carbide can be used as an ingredient of a nonmagnetic membrane.
[0015] Furthermore, it is desirable to use the metal of the silver and copper whenever [dissolution / of cobalt / whose] is 5% or less as an ingredient of a nonmagnetic membrane, silicon oxide or a zirconic acid ghost, titanium nitride or a silicon nitride, carbon, carbide, etc. Moreover, it is suitable to use a heat-resistant high ingredient, for example, silicon, and carbon as an ingredient of a nonmagnetic substrate.
[0016]
[Example]
(1) Explanatory view [of the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention] 1 (a) - (c) is the sectional view showing the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention. First, as shown in drawing 1 (a), the silver (Ag) film (nonmagnetic membrane) 12 of 5nm of thickness is formed by the spatter on the silicon substrate (nonmagnetic substrate) 11 with a diameter of 2.5 inches on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V.
[0017] Subsequently, the cobalt (Co) film (ferromagnetic) 13 of 7nm of thickness is formed by the spatter on a silver film 12 on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. Next, the silver (Ag) film 14 of 5nm of thickness is formed by the spatter on the cobalt film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. In addition, the thickness of silver films 12 and 14 and the cobalt film 13 has decided that product t-Br of the thickness (t) of a residual magnetic flux density (Br) and a record layer is set to about 100 Gauss-mu m.
[0018] Subsequently, heat-treatment for 60 minutes is performed on conditions with a temperature of 450 degrees C among the reduced pressure ambient atmosphere of 5x10 to 6 or less Torrs of pressures. Thereby, while oxidization of silver films 12 and 14 and the cobalt film 13 is prevented, as shown in drawing 1 (b), the record layer 16 which silver and cobalt diffuse mutually and crystal grain 13a of the magnitude of several nm or dozens of nm cobalt is distributing in a silver film 15 is formed. Since the cobalt film 13 is continuing before heat-treatment at this time, coercive force is small, but by heat-treatment, since crystal grain 13a of cobalt distributes in the record layer 16, high coercive force is acquired. Furthermore, if the crystal structure of cobalt turns into hexagonal close-packed structure (hcp structure) by heat-treatment, still higher coercive force will be acquired.
[0019] In addition, this heating temperature needs to adjust suitably with the ingredient of a nonmagnetic membrane and a ferromagnetic. Generally, it is in the inclination for proper heat-treatment temperature to also become high, so that the melting point of the ingredient of a nonmagnetic membrane

or a ferromagnetic becomes high. If heat-treatment temperature is 400 degrees C or more, since the counter diffusion of silver and cobalt will arise in the range of the practical heating processing time and it will moreover be easy to obtain hcp structure according to the experiment as the crystal structure of cobalt crystal grain 13a, the heating processing time can be adjusted suitably in the temperature requirement of heat-treatment of 400 degrees C or more.
[0020] Next, if the carbon (C) film 16 of 10nm of thickness is formed by the spatter on the record layer 15 on condition that argon pressure 10mTorr, the substrate temperature of 20 degrees C, 1kW of direct current power, and direct-current bias voltage 0V as shown in drawing 1 (c), a magnetic-recording medium will be created. Next, the result of having measured noise power is explained using the above-mentioned magnetic-recording medium.
[0021] Drawing 2 is property drawing showing the noise power dependency over a record frequency. An axis of abscissa shows the record frequency (MHz) expressed with the linearity graduation, and an axis of ordinate shows the noise power expressed per arbitration. It is shown all over property drawing where the same is said of the noise power of the magnetic-recording medium concerning the example of a comparison for a comparison. The magnetic-recording medium concerning the example of a comparison is the chromium film 2 of 100nm of thickness, and CoCr12Ta2 of 20nm of thickness on the nonmagnetic substrate 1 which consists of an aluminum substrate which has the configuration shown in drawing 7 and covered the NiP film. The record layer 3 which consists of film, and the protective layer 4 which consists of a carbon film of 20nm of thickness are formed in order. In addition, the t-Br product of the magnetic-recording medium of drawing 7 is about 100 Gauss-mu m.
[0022] The MR head was used as a head for playback. The peripheral speed at this time (relative velocity of a head and a magnetic-recording medium) is 10ms, and the recording density at the time of the record frequency of 20MHz is about 100 (KFCI). According to drawing 2 , by the magnetic-recording medium concerning the 1st example, noise power hardly changes to a record frequency, but by the magnetic-recording medium concerning the conventional example, noise power changes a lot with a record frequency, and it increases in monotone as a record frequency becomes high.
[0023] Although the magnetic-recording medium of noise power applied to the example of a comparison on a record frequency lower than this bordering on the record frequency of 12-13MHz is smaller, the magnetic-recording medium of noise power applied to the 1st example on a record frequency higher than this is smaller. For example, in the case of the 1st example, it will be set to about 0.8, if the case of the example of a comparison is set to 1 as it is shown in a table 1, when the record frequency of 20MHz compares noise power. Therefore, the magnetic-recording medium concerning the 1st example becomes advantageous when using it on a high record frequency.
[0024]
[A table 1]

非磁性層	強磁性層	ノイズパワー	非磁性層	強磁性層	ノイズパワー
Ag	Co	0.8	C	Co	0.8
Ag	Co90Cr10	0.75	C	Co90Cr10	0.75
Ag	Co80Pt20	0.8	C	Co80Pt20	0.8
Ag	Co50Pt50	0.8	C	Co50Pt50	0.8
Ag	Co80Sm20	0.8	C	Co80Sm20	0.8
Ag	Co89.5Sm10.5	0.8	C	Co89.5Sm10.5	0.8
Cu	Co	0.85	TiN	Co	0.85
Cu	Co90Cr10	0.8	TiN	Co90Cr10	0.8
Cu	Co80Pt20	0.75	TiN	Co80Pt20	0.75
Cu	Co50Pt50	0.8	TiN	Co50Pt50	0.8
Cu	Co80Sm20	0.8	TiN	Co80Sm20	0.8
Cu	Co89.5Sm10.5	0.8	TiN	Co89.5Sm10.5	0.8
SiO2	Co	0.8	SiN	Co	0.8
SiO2	Co90Cr10	0.85	SiN	Co90Cr10	0.85
SiO2	Co80Pt20	0.8	SiN	Co80Pt20	0.8
SiO2	Co50Pt50	0.8	SiN	Co50Pt50	0.8
SiO2	Co80Sm20	0.75	SiN	Co80Sm20	0.75
SiO2	Co89.5Sm10.5	0.8	SiN	Co89.5Sm10.5	0.8
ZrO2	Co	0.8	ZrO2	Co80Sm20	0.75
ZrO2	Co90Cr10	0.8	ZrO2	Co89.5Sm10.5	0.8
ZrO2	Co80Pt20	0.85			
ZrO2	Co50Pt50	0.8			

[0025] in order [as mentioned above,] to form the record layer 15 in the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention -- a silver film (nonmagnetic membrane) 12, the cobalt film (ferromagnetic) 13, and a silver film (nonmagnetic membrane) 14 -- this order -- and after forming membranes independently, respectively, crystal grain 13a of cobalt (ferromagnetic) is distributed in a silver film 15 by heat-treatment.

[0026] Thereby, crystal grain 13a of cobalt can make extent which does not do magnetic effect mutually estrange in the record layer 16. Therefore, magnetization distribution of a magnetic-recording medium can be equalized and the noise figure resulting from uneven magnetization distribution of the magnetization transition region of a magnetic-recording medium and its periphery can be improved. Moreover, since it becomes possible to form the record layer 16 which it is thin thickness, and has sufficient coercive force, and a t-Br product becomes below 100 Gauss-mu m according to the above-mentioned manufacture approach, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.

[0027] In addition, in the 1st example of the above, although the silver film is used as nonmagnetic membranes 12 and 14, a copper film may be used. Moreover, heat-treatment is required, in formation of the magnetic-recording medium concerning the 1st example, also when heat-treatment at quite high temperature is needed with the ingredient used as nonmagnetic membranes 12 and 14 or a ferromagnetic 13, for a certain reason, the silicon substrate which was excellent in thermal resistance as a nonmagnetic substrate 11 is used, but the carbon substrate which was excellent in thermal resistance similarly may be used.

(2) The explanatory view 3 of the manufacture approach of the magnetic-recording medium concerning the 2nd example of this invention is a sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 2nd example of this invention. A different place from the 1st example is using the carbon film instead of the silver film which sandwiches the cobalt film. Moreover, since the carbon film is used for the topmost part of a record layer, the carbon film and protective layer of a record layer are shared.

[0028] The 2nd example is explained below, referring to drawing 3 . First, the carbon film (nonmagnetic membrane) of 5nm of thickness is formed by the spatter on a silicon substrate (nonmagnetic substrate)

11 on condition that argon pressure 10mTorr, the substrate temperature of 20 degrees C, 0.2kW of alternating current power with a frequency of 13.56MHz, and direct-current bias voltage 0V.
[0029] Subsequently, the cobalt film (ferromagnetic) of 5nm of thickness is formed by the spatter on a carbon film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. Next, the carbon film of 7nm of thickness is formed by the spatter on the cobalt film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of alternating current power with a frequency of 13.56MHz, and direct-current bias voltage 0V.
[0030] Subsequently, heat-treatment for 60 minutes is performed on conditions with a temperature of 450 degrees C among the reduced pressure ambient atmosphere of 5x10 to 6 or more Torrs of degree of vacuums. Thereby, while oxidization of a carbon film and the cobalt film is prevented, the record layer 19 which carbon and cobalt diffused mutually and crystal grain 13b of the magnitude of several nm or dozens of nm cobalt distributed in the carbon film 18 is formed. Since the cobalt film is continuing before heat-treatment at this time, coercive force is small, but by heat-treatment, since crystal grain 13b of cobalt distributes in the record layer 19, high coercive force is acquired. Furthermore, if the crystal structure of the cobalt in the record layer 19 turns into hcp structure by heat-treatment, still higher coercive force will be acquired.
[0031] A magnetic-recording medium is created by the above. As shown in a table 1, when noise power with a record frequency [of the magnetic-recording medium created as mentioned above also in this case] of 20MHz set noise power of the conventional example to 1, 0.8 [lower than the conventional example] was obtained. In addition, although the protective layer is not prepared especially on the record layer 19, the protective layer which consists of a carbon film etc. further may be prepared by the case.
(3) The explanatory view 4 of the magnetic-recording medium concerning the 3rd example of this invention is a sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 3rd example.
[0032] A different place from the 1st and 2nd examples is using Co90Cr10 film instead of the cobalt film as a ferromagnetic inserted into a nonmagnetic membrane. By Co90Cr10 film, the crystal structure of the crystal grain of a ferromagnetic tends to turn into hcp structure by existence of Cr as compared with Co film. There is the description that this is easy to acquire high coercive force.
[0033] The membrane formation approach is the same as the case of membrane formation of Co film explained in the 1st and 2nd examples of the above. Thereby, crystal grain 13c of Co90Cr10 is distributed in a silver film 20, and the record layer 21 in which mutual crystal grain 13c is isolated thoroughly is formed on a silicon substrate (nonmagnetic substrate) 11. In this case, as shown in a table 1, when the conventional example was set to 1 about noise power with a record frequency of 20MHz, 0.75 [lower than the conventional example] was obtained.
[0034] In addition, SiO2 to which Co otherwise hardly dissolves although Co uses the silver film and carbon film which hardly dissolve as nonmagnetic membranes 12 and 14 which sandwich a ~~ferromagnetic 13 by the magnetic-recording medium concerning the above 1st - the 3rd example The~~ film and ZrO2 Either the film, the TiN film or the SiN film may be used. Moreover, CoA Pt100-A or (A is 70 or more, and 40-50) CoA Sm100-A (A is 83.3 or 89.5) other than Co or Co90Cr10 can be used as an ingredient of a ferromagnetic 13.
[0035] The measurement data of the noise power of the magnetic-recording medium using various combination [ingredient / an above-mentioned non-magnetic material and an above-mentioned ferromagnetic ingredient] is shown in a table 1. When all set noise power of the conventional example to 1, it becomes smaller than 1.
(4) Explain, referring to drawing 5 (a) - (c) about the magnetic recording medium concerning the 4th example using explanation of the magnetic recorder and reproducing device concerning the 4th example of this invention, next the magnetic-recording medium concerning the above 1st - the 3rd example. Drawing 5 (a) - (c) is the sectional view showing the magnetic-recording medium of a magnetic recording medium, and the part of the magnetic head.

[0036] Drawing 5 (a) shows a compound-die MR head. The head for playback and the B section show [the A section] the head for record, and, as for magnetic shielding of the head for playback, and the magnetic pole of the head for record, the soft magnetism layer 102 is shared. As shown in drawing 5 (a), in the part of the head for playback, the soft magnetism layer 101,102 as magnetic shielding sets spacing, and counters, and the above-mentioned MR component is pinched in the gap of the part 105 which meets the magnetic-recording medium 106. The leakage field from the magnetic-recording medium 106 is detected by the direct MR component.
[0037] Moreover, in the part of the head for record, the soft magnetism layer 102,104 as a magnetic pole sets spacing, and counters, and the coil 103 which generates the magnetic flux which carries out conduction of the soft magnetism layer 102,104 is formed in the gap between the soft magnetism layers 102,104. A leakage field is generated from the gap for the pair surface part 105 by this magnetic flux, and it records on the magnetic-recording medium 106.
[0038] Since the magnetic-recording medium concerning the above-mentioned example is used according to this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. Drawing 5 (b) shows the in gap mold MR head which has a flux guide. As shown in this drawing, the soft magnetism layer 111,114 as a magnetic pole sets spacing, and counters, the above-mentioned MR component is pinched in the gap of the part 115 which meets the magnetic-recording medium 116, and the coil 113 which generates the magnetic flux which carries out conduction of the soft magnetism layer 111,114 is formed in the gap between the soft magnetism layers 111,114.
[0039] MR component has withdrawn inside the magnetic head, without exposing to a part for the pair surface part 115 with the magnetic-recording medium 116 in order to avoid corrosion, or in order to avoid direct contact to a magnetic-recording medium. MR component and the electric target insulated and flux guide 112a combined magnetically is exposed to a part for the pair surface part 115. The leakage field from the magnetic-recording medium 116 goes into flux guide 112a, and is detected by MR component. In addition, MR component and an electric target insulate, and another flux guide 112b combined magnetically is formed in the other end of MR component, and the magnetic flux which passed along MR component is led to the soft magnetism layer 111,114.
[0040] Since the magnetic-recording medium concerning the above-mentioned example is used according to this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. Drawing 5 (c) shows a yoke type MR head. As shown in this drawing, the soft magnetism layer 121 as a magnetic pole, and 123a and 123b set spacing, and counter, and the coil 122 which generates the magnetic flux which carries out conduction of the soft magnetism layer 121 and the soft magnetism layers 123a and 123b is formed in the gap between the soft magnetism layer 121 and the soft magnetism layers 123a and 123b. It insulates with the soft magnetism layers 123a and 123b electrically in the part where one soft magnetism layers 123a and 123b broke off, and it is combined magnetically and MR component is arranged. It generates with a coil 122, a leakage field is generated from the gap for the pair surface part 124 by the magnetic flux which carries out conduction of 123a and the 123b to the soft magnetism layer 121, and it records on the magnetic-recording medium 125.
[0041] Since the magnetic-recording medium concerning the above-mentioned example is used in this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. In addition, in both the magnetic recording media shown in drawing 5 (a) - (c), the substrate with which the magnetic head is formed, the insulator layer between soft magnetism layers, etc. are omitted. Moreover, the magnetic-recording medium concerning the example of this invention can be used for the various magnetic recording media which have not only the above-mentioned magnetic recording medium but the write-in section, and the read-out section.
[0042] Furthermore, it is also possible to use the above-mentioned magnetic-recording medium for the magnetic recording medium only for playbacks.
[0043]
[Effect of the Invention] In the manufacture approach of the magnetic-recording medium of this invention, in order to form a record layer, after forming a nonmagnetic membrane and a ferromagnetic independently, respectively, the crystal grain of a ferromagnetic is distributed in a nonmagnetic

membrane by heat-treatment. Therefore, it becomes possible to make extent to which the crystal grain of a ferromagnetic does not do effect mutually estrange the crystal grain of a ferromagnetic in a record layer, and to equalize magnetization distribution of a magnetic-recording medium, and the noise figure resulting from uneven magnetization distribution of a magnetization transition region and its periphery can be improved.

[0044] Moreover, since it becomes possible to form the record layer which it is thin thickness, and has sufficient coercive force, and the product of a residual magnetic flux density and thickness becomes below 100 Gauss-mu m, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the manufacture approach of the magnetic-recording medium of high power in a low noise in more detail about the manufacture approach of a magnetic-recording medium.

[Translation done.]

PRIOR ART

[Description of the Prior Art] The magnetic recording medium used as external storage of an information processor requires improvement in recording density increasingly with the increment in amount of information. By the magnetic-recording medium used conventionally, if recording density is made high, a S/N ratio will fall. That is, a playback output will decline and a noise will increase.
[0003] Furthermore, since the S/N ratio of the reproducing head improved by leaps and bounds by utilization of a magneto-resistive effect mold MR head, the noise of the magnetic-recording medium which was seldom conspicuous until now came to occupy most total noises of a magnetic disk drive. Therefore, in order to obtain the magnetic disk drive of a high S/N ratio, the magnetic-recording medium of a low noise is demanded with the high playback output.
[0004] The main things originate in the ambiguity of the boundary of the magnetization transition region by dispersion in magnetization of a magnetization transition region among the causes of generating of the noise of a magnetic-recording medium, and the ambiguity originates in the magnetic interaction between the crystal grain of the ferromagnetic which constitutes a ferromagnetic layer. That is, it is thought that it is because the clearance of the crystal grain of an adjoining ferromagnetic varies.
[0005] For reduction of the noise of a magnetic-recording medium, it is required to weaken the magnetic interaction between the crystal grain of this ferromagnetic, as the clearance more than fixed is maintained among the crystal grain of all adjoining ferromagnetics. As for the record layer of the conventional magnetic-recording medium, it is common to use the thin film which created the 3 yuan or 4 yuan alloy layer which made chromium and cobalt the keynote by sputtering. The segregation of a ferromagnetic part and a nonmagnetic part was urged according to the presentation and creation conditions, and reduction of a noise was in drawing.
[0006] The configuration of the magnetic-recording medium applied to the conventional example at drawing 7 is shown. It is [the chromium film 2 and] CoCr12Ta2 on the nonmagnetic substrate 1 which consists of an aluminum substrate which covered the NiP film as shown in drawing 7. The record layer 3 which consists of film, and the protective layer 4 which consists of a carbon film are formed in order.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] In the manufacture approach of the magnetic-recording medium of this invention, in order to form a record layer, after forming a nonmagnetic membrane and a ferromagnetic independently, respectively, the crystal grain of a ferromagnetic is distributed in a nonmagnetic membrane by heat-treatment. Therefore, it becomes possible to make extent to which the crystal grain of a ferromagnetic does not do effect mutually estrange the crystal grain of a ferromagnetic in a record layer, and to equalize magnetization distribution of a magnetic-recording medium, and the noise figure resulting from uneven magnetization distribution of a magnetization transition region and its periphery can be improved.
[0044] Moreover, since it becomes possible to form the record layer which it is thin thickness, and has sufficient coercive force, and the product of a residual magnetic flux density and thickness becomes below 100 Gauss-mu m, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since the cobalt system alloy conventionally used as a record layer 3 was a dissolution system fundamentally, even if it promoted the segregation according to a presentation and creation conditions, it was difficult to isolate the crystal grain of a ferromagnetic thoroughly, and it difficult [it] to cut off the magnetic interaction between these.
[0008] Moreover, after creating at once the 2 yuan or 3 yuan alloy layer of non-magnetic material, such as silver and copper, and the ferromagnetic which cannot dissolve easily to this non-magnetic material by sputtering as the formation approach of a ferromagnetic layer as indicated by JP,59-42642,A and JP,59-220907,A, there is the approach of heat-treating that thin film and forming the record layer of a magnetic-recording medium. Thereby, high coercive force is acquired.
[0009] However, thickness is formed thickly and the above-mentioned ferromagnetic layer is considered that a t-Br product becomes as high as 2000 or more. For this reason, in the magnetic recording medium which used the magneto-resistive effect mold MR head for the playback section, when using this ferromagnetic layer as a record layer of a magnetic-recording medium, the engine performance of a magneto-resistive effect mold MR head with high sensibility is not matched, but lowering of a playback output is caused on the contrary. By the way, as for especially the t-Br product of the magnetic-recording medium applied to a magneto-resistive effect mold MR head, it is desirable that they are below 100 Gauss-mu m below 150 Gauss-mu m.
[0010] Therefore, although thickness of the above-mentioned record layer needed to be made thin, when the ferromagnetic layer of thin thickness was formed by the above-mentioned spatter, there was a problem that magnetic properties required about coercive force, a residual magnetic flux density, etc. were not acquired. This invention is created in view of the trouble of the above-mentioned conventional example, and it aims at offering the manufacture approach of a magnetic-recording medium that thickness of a record layer can be made thin and magnetic properties required about coercive force, a residual magnetic flux density, etc. can be acquired while it isolates the crystal grain of the ferromagnetic in a record layer mutually and controls the magnetic interaction between these.

[Translation done.]

MEANS

[Means for Solving the Problem] After the above-mentioned technical problem carries out the laminating of a nonmagnetic membrane, a ferromagnetic, and the nonmagnetic membrane to the 1st on a nonmagnetic substrate at order, Heat-treat and it is attained by the manufacture approach of the magnetic-recording medium characterized by forming the record layer which the crystal grain of a ferromagnetic distributed into a nonmagnetic membrane. It is attained by the manufacture approach of the magnetic-recording medium a publication by the 1st invention characterized by making temperature of said heat-treatment into 400 degrees C or more the 2nd. Whenever [dissolution / of the crystal grain of said ferromagnetic in said nonmagnetic membrane] is attained in ordinary temperature by the 3rd by the manufacture approach of a magnetic-recording medium given in the 1st or 2nd invention characterized by being 5% or less. The residual magnetization of said record layer and the product of thickness which were formed by the 4th It is attained by either the 1st characterized by being below 100 Gauss-mu m thru/or the 3rd invention by the manufacture approach of the magnetic-recording medium a publication. A metal, an oxide, a nitride, carbon, or carbide is used for the 5th as said nonmagnetic membrane. It is attained by either the 1st characterized by using the alloy which uses cobalt or cobalt as a principal component as said ferromagnetic thru/or the 4th invention by the manufacture approach of the magnetic-recording medium a publication. It is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by said metal being silver or copper the 6th. To the 7th said oxide It is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by being silicon oxide or a zirconic acid ghost. To the 8th said nitride The alloy which is attained by the manufacture approach of the magnetic-recording medium a publication by the 5th invention characterized by being titanium nitride or a silicon nitride, and uses said cobalt as a principal component the 9th CoA Cr100-A (A is 90 or more), It is attained by either the 1st characterized by being any one of CoA Pt100-A or (A being 70 or more, and 40-50) CoA Sm100-A (A being 83.3 or 89.5) thru/or the 8th invention by the manufacture approach of the magnetic-recording medium a publication. To the 10th Said nonmagnetic substrate is attained by either the 1st characterized by being silicon or carbon thru/or the 9th invention by the manufacture approach of the magnetic-recording medium a publication.

[Translation done.]

OPERATION

[Function] In the manufacture approach of the magnetic-recording medium of this invention, in order to form a record layer, after forming a nonmagnetic membrane, a ferromagnetic, and a nonmagnetic membrane independently, respectively, the crystal grain of a ferromagnetic is distributed in a nonmagnetic membrane by heat-treatment. Thereby, it becomes possible to make extent it the crystal grain of all adjoining ferromagnetics does magnetic effect mutually, and they do not suit in a record layer estrange the crystal grain of a ferromagnetic. In this case, that effectiveness will become remarkable if the non-magnetic material to which a ferromagnetic hardly dissolves especially is used.
[0013] Therefore, magnetization distribution of a magnetic-recording medium can be equalized and the noise figure resulting from uneven magnetization distribution of the magnetization transition region of a magnetic-recording medium and its periphery can be improved. Moreover, since it becomes possible to form a record layer which it is thin thickness, and has sufficient coercive force, and the product of a residual magnetic flux density and thickness becomes below 100 Gauss-mu m by the above-mentioned manufacture approach, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.
[0014] Furthermore, while heat-treating more than at an elevated temperature, for example, 400 degrees C, and promoting counter diffusion, it becomes possible to acquire still higher coercive force by acquiring the crystal structure which produces magnetization sufficient as crystal grain of the dispersed ferromagnetic. In the above, the alloy which uses cobalt or cobalt as a principal component, for example, CoA Cr100-A, (A is 90 or more), CoA Pt100-A, or (A is 70 or more, and 40-50) CoA Sm100-A (A is 83.3 or 89.5) can be used as an ingredient of a ferromagnetic, and a metal, an oxide, a nitride, carbon, or carbide can be used as an ingredient of a nonmagnetic membrane.
[0015] Furthermore, it is desirable to use the metal of the silver and copper whenever [dissolution / of cobalt / whose] is 5% or less as an ingredient of a nonmagnetic membrane, silicon oxide or a zirconic acid ghost, titanium nitride or a silicon nitride, carbon, carbide, etc. Moreover, it is suitable to use a heat-resistant high ingredient, for example, silicon, and carbon as an ingredient of a nonmagnetic substrate.

[Translation done.]

* NOTICES *

EXAMPLE

[Example]
(1) Explanatory view [of the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention] 1 (a) - (c) is the sectional view showing the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention. First, as shown in drawing 1 (a), the silver (Ag) film (nonmagnetic membrane) 12 of 5nm of thickness is formed by the spatter on the silicon substrate (nonmagnetic substrate) 11 with a diameter of 2.5 inches on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V.
[0017] Subsequently, the cobalt (Co) film (ferromagnetic) 13 of 7nm of thickness is formed by the spatter on a silver film 12 on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. Next, the silver (Ag) film 14 of 5nm of thickness is formed by the spatter on the cobalt film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. In addition, the thickness of silver films 12 and 14 and the cobalt film 13 has decided that product t-Br of the thickness (t) of a residual magnetic flux density (Br) and a record layer is set to about 100 Gauss-mu m.
[0018] Subsequently, heat-treatment for 60 minutes is performed on conditions with a temperature of 450 degrees C among the reduced pressure ambient atmosphere of 5x10 to 6 or less Torrs of pressures. Thereby, while oxidization of silver films 12 and 14 and the cobalt film 13 is prevented, as shown in drawing 1 (b), the record layer 16 which silver and cobalt diffuse mutually and crystal grain 13a of the magnitude of several nm or dozens of nm cobalt is distributing in a silver film 15 is formed. Since the cobalt film 13 is continuing before heat-treatment at this time, coercive force is small, but by heat-treatment, since crystal grain 13a of cobalt distributes in the record layer 16, high coercive force is acquired. Furthermore, if the crystal structure of cobalt turns into hexagonal close-packed structure (hcp structure) by heat-treatment, still higher coercive force will be acquired.
[0019] In addition, this heating temperature needs to adjust suitably with the ingredient of a nonmagnetic membrane and a ferromagnetic. Generally, it is in the inclination for proper heat-treatment temperature to also become high, so that the melting point of the ingredient of a nonmagnetic membrane or a ferromagnetic becomes high. If heat-treatment temperature is 400 degrees C or more, since the counter diffusion of silver and cobalt will arise in the range of the practical heating processing time and it will moreover be easy to obtain hcp structure according to the experiment as the crystal structure of cobalt crystal grain 13a, the heating processing time can be adjusted suitably in the temperature requirement of heat-treatment of 400 degrees C or more.
[0020] Next, if the carbon (C) film 16 of 10nm of thickness is formed by the spatter on the record layer 15 on condition that argon pressure 10mTorr, the substrate temperature of 20 degrees C, 1kW of direct current power, and direct-current bias voltage 0V as shown in drawing 1 (c), a magnetic-recording medium will be created. Next, the result of having measured noise power is explained using the above-mentioned magnetic-recording medium.

[0021] Drawing 2 is property drawing showing the noise power dependency over a record frequency. An axis of abscissa shows the record frequency (MHz) expressed with the linearity graduation, and an axis of ordinate shows the noise power expressed per arbitration. It is shown all over property drawing where the same is said of the noise power of the magnetic-recording medium concerning the example of a comparison for a comparison. The magnetic-recording medium concerning the example of a comparison is the chromium film 2 of 100nm of thickness, and CoCr12Ta2 of 20nm of thickness on the nonmagnetic substrate 1 which consists of an aluminum substrate which has the configuration shown in drawing 7 and covered the NiP film. The record layer 3 which consists of film, and the protective layer 4 which consists of a carbon film of 20nm of thickness are formed in order. In addition, the t-Br product of the magnetic-recording medium of drawing 7 is about 100 Gauss-mu m.
[0022] The MR head was used as a head for playback. The peripheral speed at this time (relative velocity of a head and a magnetic-recording medium) is 10ms, and the recording density at the time of the record frequency of 20MHz is about 100 (KFCI). According to drawing 2 , by the magnetic-recording medium concerning the 1st example, noise power hardly changes to a record frequency, but by the magnetic-recording medium concerning the conventional example, noise power changes a lot with a record frequency, and it increases in monotone as a record frequency becomes high.
[0023] Although the magnetic-recording medium of noise power applied to the example of a comparison on a record frequency lower than this bordering on the record frequency of 12-13MHz is smaller, the magnetic-recording medium of noise power applied to the 1st example on a record frequency higher than this is smaller. For example, in the case of the 1st example, it will be set to about 0.8, if the case of the example of a comparison is set to 1 as it is shown in a table 1, when the record frequency of 20MHz compares noise power. Therefore, the magnetic-recording medium concerning the 1st example becomes advantageous when using it on a high record frequency.
[0024]
[A table 1]

非磁性層	強磁性層	ノイズパワー	非磁性層	強磁性層	ノイズパワー
Ag	Co	0.8	C	Co	0.8
Ag	Co90Cr10	0.75	C	Co90Cr10	0.75
Ag	Co80Pt20	0.8	C	Co80Pt20	0.8
Ag	Co50Pt50	0.8	C	Co50Pt50	0.8
Ag	Co80Sm20	0.8	C	Co80Sm20	0.8
Ag	Co89.5Sm10.5	0.8	C	Co89.5Sm10.5	0.8
Cu	Co	0.85	TiN	Co	0.85
Cu	Co90Cr10	0.8	TiN	Co90Cr10	0.8
Cu	Co80Pt20	0.75	TiN	Co80Pt20	0.75
Cu	Co50Pt50	0.8	TiN	Co50Pt50	0.8
Cu	Co80Sm20	0.8	TiN	Co80Sm20	0.8
Cu	Co89.5Sm10.5	0.8	TiN	Co89.5Sm10.5	0.8
SiO2	Co	0.8	SiN	Co	0.8
SiO2	Co90Cr10	0.85	SiN	Co90Cr10	0.85
SiO2	Co80Pt20	0.8	SiN	Co80Pt20	0.8
SiO2	Co50Pt50	0.8	SiN	Co50Pt50	0.8
SiO2	Co80Sm20	0.75	SiN	Co80Sm20	0.75
SiO2	Co89.5Sm10.5	0.8	SiN	Co89.5Sm10.5	0.8
ZrO2	Co	0.8	ZrO2	Co80Sm20	0.75
ZrO2	Co90Cr10	0.8	ZrO2	Co89.5Sm10.5	0.8
ZrO2	Co80Pt20	0.85			
ZrO2	Co50Pt50	0.8			

[0025] in order [as mentioned above,] to form the record layer 15 in the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention -- a silver film (nonmagnetic membrane) 12, the cobalt film (ferromagnetic) 13, and a silver film (nonmagnetic membrane) 14 -- this

order -- and after forming membranes independently, respectively, crystal grain 13a of cobalt (ferromagnetic) is distributed in a silver film 15 by heat-treatment.

[0026] Thereby, crystal grain 13a of cobalt can make extent which does not do magnetic effect mutually estrange in the record layer 16. Therefore, magnetization distribution of a magnetic-recording medium can be equalized and the noise figure resulting from uneven magnetization distribution of the magnetization transition region of a magnetic-recording medium and its periphery can be improved. Moreover, since it becomes possible to form the record layer 16 which it is thin thickness, and has sufficient coercive force, and a t-Br product becomes below 100 Gauss-mu m according to the above-mentioned manufacture approach, the engine performance of the MR head of high sensitivity is made to suit, and a high playback output can be obtained.

[0027] In addition, in the 1st example of the above, although the silver film is used as nonmagnetic membranes 12 and 14, a copper film may be used. Moreover, heat-treatment is required, in formation of the magnetic-recording medium concerning the 1st example, also when heat-treatment at quite high temperature is needed with the ingredient used as nonmagnetic membranes 12 and 14 or a ferromagnetic 13, for a certain reason, the silicon substrate which was excellent in thermal resistance as a nonmagnetic substrate 11 is used, but the carbon substrate which was excellent in thermal resistance similarly may be used.

(2) The explanatory view 3 of the manufacture approach of the magnetic-recording medium concerning the 2nd example of this invention is a sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 2nd example of this invention. A different place from the 1st example is using the carbon film instead of the silver film which sandwiches the cobalt film. Moreover, since the carbon film is used for the topmost part of a record layer, the carbon film and protective layer of a record layer are shared.

[0028] The 2nd example is explained below, referring to drawing 3 . First, the carbon film (nonmagnetic membrane) of 5nm of thickness is formed by the spatter on a silicon substrate (nonmagnetic substrate) 11 on condition that argon pressure 10mTorr, the substrate temperature of 20 degrees C, 0.2kW of alternating current power with a frequency of 13.56MHz, and direct-current bias voltage 0V.

[0029] Subsequently, the cobalt film (ferromagnetic) of 5nm of thickness is formed by the spatter on a carbon film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of direct current power, and direct-current bias voltage 0V. Next, the carbon film of 7nm of thickness is formed by the spatter on the cobalt film on condition that argon pressure 5mTorr, the substrate temperature of 20 degrees C, 0.2kW of alternating current power with a frequency of 13.56MHz, and direct-current bias voltage 0V.

[0030] Subsequently, heat-treatment for 60 minutes is performed on conditions with a temperature of 450 degrees C among the reduced pressure ambient atmosphere of 5x10 to 6 or more Torrs of degree of vacuums. Thereby, while oxidization of a carbon film and the cobalt film is prevented, the record layer 19 which carbon and cobalt diffused mutually and crystal grain 13b of the magnitude of several nm or dozens of nm cobalt distributed in the carbon film 18 is formed. Since the cobalt film is continuing before heat-treatment at this time, coercive force is small, but by heat-treatment, since crystal grain 13b of cobalt distributes in the record layer 19, high coercive force is acquired. Furthermore, if the crystal structure of the cobalt in the record layer 19 turns into hcp structure by heat-treatment, still higher coercive force will be acquired.

[0031] A magnetic-recording medium is created by the above. As shown in a table 1, when noise power with a record frequency [of the magnetic-recording medium created as mentioned above also in this case] of 20MHz set noise power of the conventional example to 1, 0.8 [lower than the conventional example] was obtained. In addition, although the protective layer is not prepared especially on the record layer 19, the protective layer which consists of a carbon film etc. further may be prepared by the case.

(3) The explanatory view 4 of the magnetic-recording medium concerning the 3rd example of this invention is a sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 3rd example.

[0032] A different place from the 1st and 2nd examples is using Co90Cr10 film instead of the cobalt film as a ferromagnetic inserted into a nonmagnetic membrane. By Co90Cr10 film, the crystal structure of the crystal grain of a ferromagnetic tends to turn into hcp structure by existence of Cr as compared with Co film. There is the description that this is easy to acquire high coercive force.
[0033] The membrane formation approach is the same as the case of membrane formation of Co film explained in the 1st and 2nd examples of the above. Thereby, crystal grain 13c of Co90Cr10 is distributed in a silver film 20, and the record layer 21 in which mutual crystal grain 13c is isolated thoroughly is formed on a silicon substrate (nonmagnetic substrate) 11. In this case, as shown in a table 1, when the conventional example was set to 1 about noise power with a record frequency of 20MHz, 0.75 [lower than the conventional example] was obtained.
[0034] In addition, SiO2 to which Co otherwise hardly dissolves although Co uses the silver film and carbon film which hardly dissolve as nonmagnetic membranes 12 and 14 which sandwich a ferromagnetic 13 by the magnetic-recording medium concerning the above 1st - the 3rd example The film and ZrO2 Either the film, the TiN film or the SiN film may be used. Moreover, CoA Pt100-A or (A is 70 or more, and 40-50) CoA Sm100-A (A is 83.3 or 89.5) other than Co or Co90Cr10 can be used as an ingredient of a ferromagnetic 13.
[0035] The measurement data of the noise power of the magnetic-recording medium using various combination [ingredient / an above-mentioned non-magnetic material and an above-mentioned ferromagnetic ingredient] is shown in a table 1. When all set noise power of the conventional example to 1, it becomes smaller than 1.
(4) Explain, referring to drawing 5 (a) - (c) about the magnetic recording medium concerning the 4th example using explanation of the magnetic recorder and reproducing device concerning the 4th example of this invention, next the magnetic-recording medium concerning the above 1st - the 3rd example. Drawing 5 (a) - (c) is the sectional view showing the magnetic-recording medium of a magnetic recording medium, and the part of the magnetic head.
[0036] Drawing 5 (a) shows a compound-die MR head. The head for playback and the B section show [the A section] the head for record, and, as for magnetic shielding of the head for playback, and the magnetic pole of the head for record, the soft magnetism layer 102 is shared. As shown in drawing 5 (a), in the part of the head for playback, the soft magnetism layer 101,102 as magnetic shielding sets spacing, and counters, and the above-mentioned MR component is pinched in the gap of the part 105 which meets the magnetic-recording medium 106. The leakage field from the magnetic-recording medium 106 is detected by the direct MR component.
[0037] Moreover, in the part of the head for record, the soft magnetism layer 102,104 as a magnetic pole sets spacing, and counters, and the coil 103 which generates the magnetic flux which carries out conduction of the soft magnetism layer 102,104 is formed in the gap between the soft magnetism layers 102,104. A leakage field is generated from the gap for the pair surface part 105 by this magnetic flux, and it records on the magnetic-recording medium 106.
[0038] Since the magnetic-recording medium concerning the above-mentioned example is used according to this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. Drawing 5 (b) shows the in gap mold MR head which has a flux guide. As shown in this drawing, the soft magnetism layer 111,114 as a magnetic pole sets spacing, and counters, the above-mentioned MR component is pinched in the gap of the part 115 which meets the magnetic-recording medium 116, and the coil 113 which generates the magnetic flux which carries out conduction of the soft magnetism layer 111,114 is formed in the gap between the soft magnetism layers 111,114.
[0039] MR component has withdrawn inside the magnetic head, without exposing to a part for the pair surface part 115 with the magnetic-recording medium 116 in order to avoid corrosion, or in order to avoid direct contact to a magnetic-recording medium. MR component and the electric target insulated and flux guide 112a combined magnetically is exposed to a part for the pair surface part 115. The leakage field from the magnetic-recording medium 116 goes into flux guide 112a, and is detected by MR component. In addition, MR component and an electric target insulate, and another flux guide 112b combined magnetically is formed in the other end of MR component, and the magnetic flux which

passed along MR component is led to the soft magnetism layer 111,114.
[0040] Since the magnetic-recording medium concerning the above-mentioned example is used according to this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. Drawing 5 (c) shows a yoke type MR head. As shown in this drawing, the soft magnetism layer 121 as a magnetic pole, and 123a and 123b set spacing, and counter, and the coil 122 which generates the magnetic flux which carries out conduction of the soft magnetism layer 121 and the soft magnetism layers 123a and 123b is formed in the gap between the soft magnetism layer 121 and the soft magnetism layers 123a and 123b. It insulates with the soft magnetism layers 123a and 123b electrically in the part where one soft magnetism layers 123a and 123b broke off, and it is combined magnetically and MR component is arranged. It generates with a coil 122, a leakage field is generated from the gap for the pair surface part 124 by the magnetic flux which carries out conduction of 123a and the 123b to the soft magnetism layer 121, and it records on the magnetic-recording medium 125.
[0041] Since the magnetic-recording medium concerning the above-mentioned example is used in this magnetic recording medium, high density record is possible, and a playback output is high, and a noise is small. In addition, in both the magnetic recording media shown in drawing 5 (a) - (c), the substrate with which the magnetic head is formed, the insulator layer between soft magnetism layers, etc. are omitted. Moreover, the magnetic-recording medium concerning the example of this invention can be used for the various magnetic recording media which have not only the above-mentioned magnetic recording medium but the write-in section, and the read-out section.
[0042] Furthermore, it is also possible to use the above-mentioned magnetic-recording medium for the magnetic recording medium only for playbacks.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 (a) - (c) is the sectional view showing the manufacture approach of the magnetic-recording medium concerning the 1st example of this invention.
[Drawing 2] Drawing 2 is property drawing showing the measurement result of the noise power of the magnetic-recording medium created by the manufacture approach concerning the 1st example of this invention.
[Drawing 3] Drawing 3 is the sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 2nd example of this invention.
[Drawing 4] Drawing 4 is the sectional view showing the magnetic-recording medium created by the manufacture approach concerning the 3rd example of this invention.
[Drawing 5] Drawing 5 (a) is the sectional view showing a common type MR head, drawing 5 (b) is the sectional view showing an in gap type MR head, and drawing 5 (c) is the sectional view showing a yoke type MR head.
[Drawing 6] Drawing 6 is the sectional view showing the magnetic-recording medium created by the manufacture approach concerning the conventional example.
[Description of Notations]
11 Nonmagnetic Substrate,
12 14 Nonmagnetic membrane,
13 Ferromagnetic,
13a-13c Crystal grain,
15 20 Silver film,
16, 19, 21 Record layer,
17 Protective Layer,
18 Carbon Film,
101, 102, 104, 111,114,121,123a, 123b Soft magnetism layer,
103,113,122 Coil,
105,115,124 Part which meets a magnetic-recording medium,
106,116,125 Magnetic-recording medium,
112a, 112b Flux guide.

[Translation done.]

* NOTICES *

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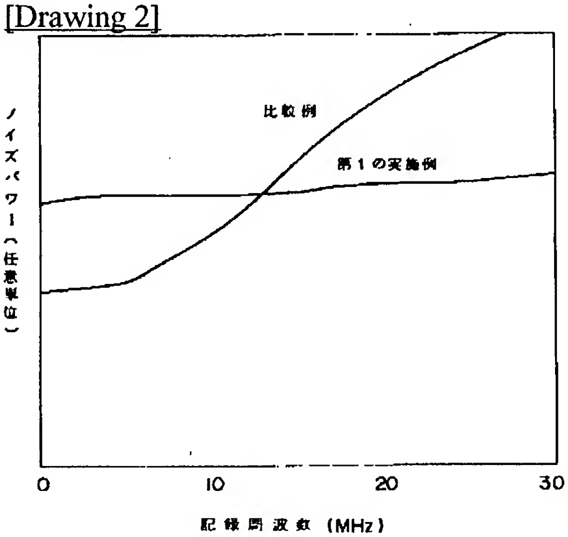
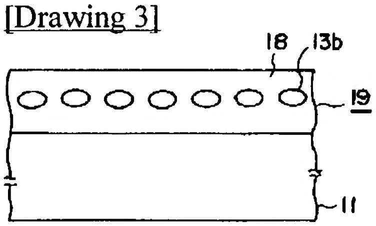
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

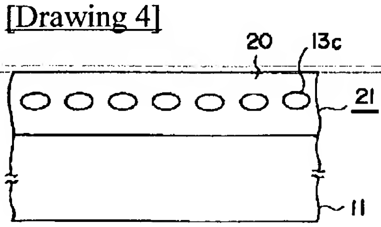
[Drawing 2]



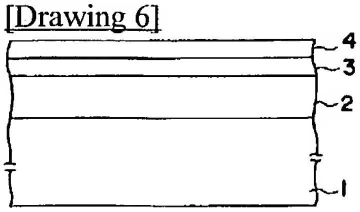
[Drawing 3]



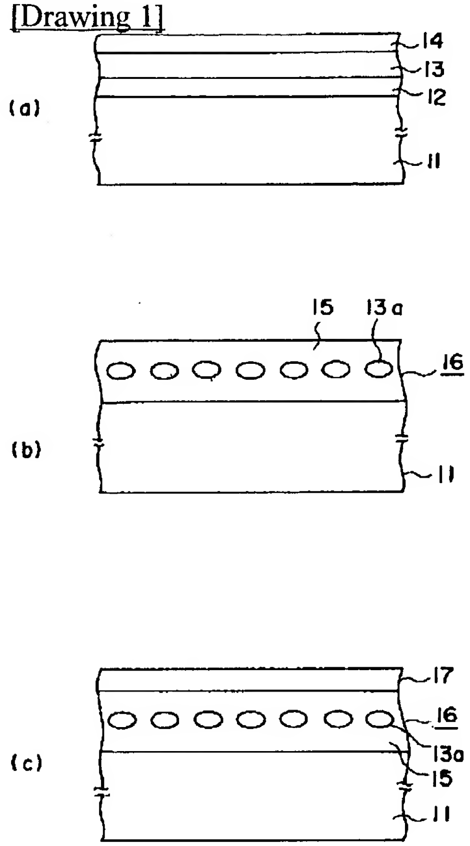
[Drawing 4]



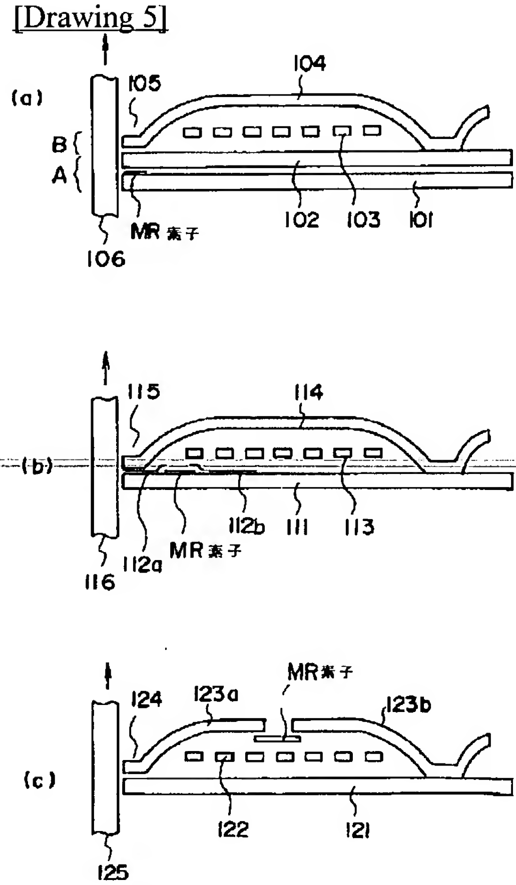
[Drawing 6]



[Drawing 1]



[Drawing 5]



[Translation done.]